

EXPERIENCES IN THE NATO PRE-PATHFINDER DIMUNDS 2000 FEDERATION

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ABSTRACT

The North Atlantic Treaty Organization (NATO) has developed and adopted a Modeling and Simulation Master Plan that provides guidance for the establishment of a NATO M&S capability. While organizational and procedural details are being developed, technical pre-pathfinder activities are being conducted to build skills within the NATO community and demonstrate the technical and procedural viability of using the High Level Architecture as the prescribed foundation for NATO federations. The DiMuNDS 2000 federation is being developed under a cooperative agreement between France, Germany, Netherlands, NATO C3 Agency, United Kingdom, and United States. This paper will present a description and status of the federation and the lessons learned with the process utilized for federation development and execution.

1 INTRODUCTION

The North Atlantic Treaty Organization (NATO) has developed and adopted a Modeling and Simulation Master Plan (NMSMP) that provides guidance for the establishment of a NATO M&S capability. The NMSMP calls for the establishment of an organizational structure to manage simulation activities, the provision of common services to the NATO M&S community, and a Pathfinder project as a “proof of concept” for the application of simulation within military exercises.

The NATO Simulation Policy Group (NSPG) and the Simulation Coordination Office (SCO) are identified in the NMSMP as the organizations to manage NATO simulation activities. Figure 1 shows how the NSPG and SCO fit within the NATO organizational structure. Upon approval of the NSPG Terms of Reference (TOR) in May 1999, the Research and Technology Board (RTB) renamed the NSPG to the NATO Modelling and Simulation Group (NMSG).

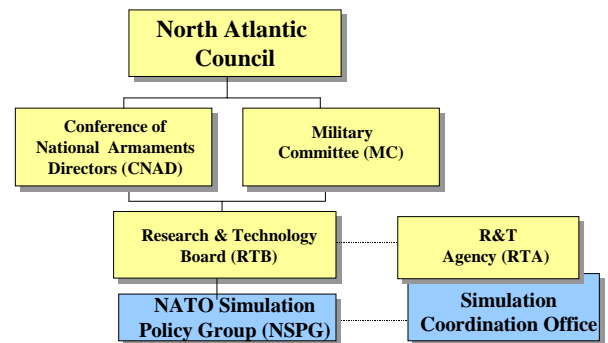


Figure 1: Organizational Structure for NATO Simulation

While the NSPG and SCO organizations are being established and procedural details are being developed, technical pre-pathfinder activities are being conducted to build skills within the NATO community and demonstrate the technical and procedural viability of using the US DoD High Level Architecture as the prescribed foundation for NATO federations. The Pathfinder activity called for in the NMSMP will leverage the experiences and lessons learned from the pre-pathfinder activities to fulfill its NMSMP requirements.

The Distributed Multi-National Defense Simulation (DiMuNDS) 2000 federation is a pre-pathfinder activity that is being developed under a cooperative agreement between France, Germany, Netherlands, NATO C3 Agency, United Kingdom, and United States. This paper will describe the DiMuNDS 2000 federation and the process being utilized in its development.

2 DIMUNDS 2000

The DiMuNDS 2000 project will develop and demonstrate a multi-national HLA federation designed to address the requirements posed by an actual operational application. This project is the first step to support the NATO M&S Master Plan requirement of supporting the CJTF computer aided exercise (CAX) training. The project will develop a working HLA federation execution that initially focuses on

training the Land Component Command staff within a joint operational context. In addition, the federation will include explicit representation of both air and naval command elements. The federation will be developed based upon inputs from across the CJTF component commands to ensure an open and extensible Federation Object Model (FOM) and reusable federate components that can be leveraged for future NATO CJTF federations.

A set of simulations were chosen from the NATO Multi-National Working Group on Interoperability of Operational Environment Simulation Models (MNWG) representatives' offerings that support the project's initial focus on the Land Component Command staff training within a joint operational context. The simulations chosen can be extended/supplemented to support training of additional Component Command's staff after the proof-of-principle has been demonstrated. The federation is composed of four national simulations and a set of tools to provide run-time support of the federation execution. The federation is depicted in Figure 2 and each of the participating systems are described below.

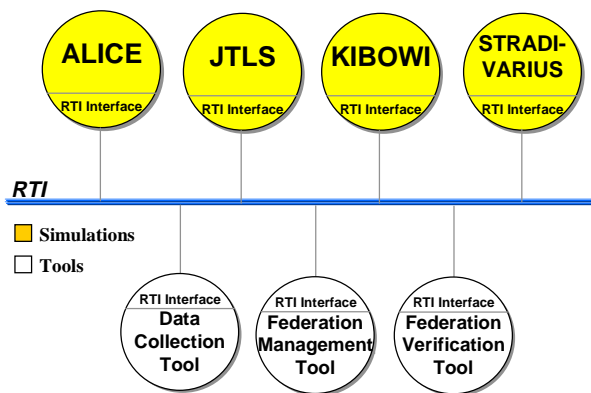


Figure 2: DiMuNDS 2000 Federation

ALICE (Germany): ALICE will provide air to air combat and air to ground combat by interacting with the STRADIVARIUS and KIBOWI systems.

Data Collection Tool (United States): The DCT will provide data collection, analysis, and reporting capabilities to the federation execution.

Federation Management Tool (United States): The FMT will provide run-time monitoring and control of the federation execution.

Federation Verification Tool (United States): The FVT will provide run-time monitoring of the federation execution to compare the actual execution to the execution plan.

Joint Theater Level Simulation (United Kingdom): JTLS is an aggregate simulation that will provide the maritime operations, logistics support, and some command and control.

KIBOWI (The Netherlands): KIBOWI will provide ground to ground and ground to air combat by interacting with the ALICE, STRADIVARIUS, and JTLS system.

STRADIVARIUS (France): Stradivarius will provide air to air combat and air to ground combat by interacting with the ALICE and KIBOWI systems.

3 DEVELOPMENT PROCESS & STATUS

A primary objective of the DiMuNDS 2000 project is to build skills within the NATO community in HLA federation development. To achieve this objective, the HLA Federation Development and Execution Process (FEDEP) Document (DMSO 1999a) is being used as a guide. The FEDEP describes the set of activities that would typically occur during the lifecycle of a federation project. The accompanying HLA FEDEP Checklist Document (DMSO 1999b) is also being used to identify specific steps that may be required based on the experiences of previous federation development efforts in the United States. It is believed that the development of NATO federations may require some additional activities that have not been encountered in previous federations. The following sections will discuss the process utilized and will identify additional steps that may be unique to NATO or other multi-national federation efforts. At the time of this writing the DiMuNDS 2000 project is in the design phase of the lifecycle, therefore, sections 3.4 through 3.6 will discuss the general plans for those phases.

3.1 Define Federation Objectives

The definition of federation objectives is typically a cooperative effort between the user/sponsor and the federation manager. This phase in the FEDEP is intended to describe the purpose of the federation, the mission area in which it will be applied, the critical operational issues to be addressed, and any givens about specific systems to incorporate or operational environments to be used.

The NATO MNWG on Interoperability of Operational Environment Simulations (MNWG) has bi-annual meetings to discuss the state of M&S within NATO and participating nations. In previous years, the MNWG sponsored the original DiMuNDS confederation that was a multi-national effort utilizing the Aggregate Level Simulation Protocol (ALSP). In order to support the NMSMP, the MNWG sponsored a set of discussions beginning in 1997 to foster a cooperative effort amongst participating nations for the development of a pre-pathfinder federation using national simulations and resources. In April 1999, the MNWG agreed upon the objective of the federation and the candidate simulations based upon the offerings of national representatives.

The objective of the DiMuNDS 2000 federation is to build skills within the NATO community in federation

development while developing a multi-national system that can be leveraged in the NATO Pathfinder activity to support the training of the Command staff, Combined-Joint Task Force (CJTF). Based on the nations that were able to participate in the project the simulations were assessed based primarily on the level of resolution that they represented various forces to ensure that the systems were compatible and that the level of representation was appropriate for CJTF mission areas. The MNWG then formed an Integrated Product Team (IPT) to handle the more technical details and to carry forward the project development effort.

Due to the nature of the cooperative agreement between the sovereign nations, special considerations were given for the formalization of the project participants and the security classification of the system to be developed. In order to ensure the participating nations were empowered to fulfill the requirements necessitated by the project plan, Letters of Agreement (LOA) were drafted that listed the anticipated requirements for each nation's participation. The LOAs were signed by each participating nation's Defense Department and provided to the Chairperson of the NATO MNWG on Interoperability of Operational Environment Simulations. The IPT considered the possibility of developing a classified system; however, it was agreed that given the limited time and budget for the project that it was not feasible to address classification issues within the DiMuNDS 2000 project.

3.2 Develop Federation Conceptual Model

The conceptual model development activities are conducted to define the range of simulated units, their attributes and behaviors that are necessary to meet the users' objectives within the simulated context. These definitions are a simulation independent abstraction of the real world that provides the basis for determining the constituent federates of a federation, their responsibilities within the federation, and the behavioral context of the simulation scenario.

Since DiMuNDS 2000 is a pre-pathfinder project with the primary objective of building federation development skills within NATO and providing a system that can be leveraged in the Pathfinder activity we took a different approach than some federations might. The conceptual model was first developed based on the breadth of operational requirements that would be required of the Combined-Joint Task Force. Based on the high-level definition of the breadth of operational requirements we compared the capabilities of the simulations that were available to define the operational requirements that could be supported with the system and within the project schedule. We felt it was important to document the breadth of requirements, even if at a high level, so that as

an outcome of the project we could identify the areas of operational requirements that are not implemented.

3.2.1 Scenario

The scenario provides the operational context of the simulation system. It includes descriptions of the military operations of interest, key behavioral events, number and types of simulated entities, geographic areas of interest, etc. The DiMuNDS 2000 scenario is primarily a peace keeping operation with some light warfare for suppression of hostility. The scenario is defined within four phases of activity.

Phase 1: crisis build-up with limited air and ground activity, intelligence collection, movement and deployment of forces based on threat and intentions, and force protection;

Phase 2: creation of safe havens, activation of a humanitarian aid program, activation of a sea and air embargo;

Phase 3: implementation of de-militarized zone, enforcement of a no-fly zone and a no-weapons zone;

Phase 4: support and protect the return of refugees, prepare and execute the withdrawal of forces.

The proposed geographical setting for the scenario is a fictitious part of the world in the vicinity of Europe. The playbox will be relatively small with at most five different countries. The five countries fall into four sides in the scenario including: allies, neutral, friendly, and hostile.

3.2.2 Conceptual Analysis

The conceptual analysis activity is conducted to specify the behaviors that must be modeled within the federation to accurately execute the scenario. The rigor that is applied to conceptual analysis is dependent on the required fidelity/validity of the federation. The DiMuNDS 2000 conceptual model was developed based on the NC3A experiences with on-going training exercises and systems that support similar operational contexts.

3.2.3 Federation Requirements

The definition of requirements is conducted to specify the set of things that a federation must provide in order to implement the scenario, conceptual analysis behaviors, and ultimately the user's objectives. The specified requirements are the foundation that other activities will be built upon and implicitly will include a description of the simulation scenario and types of simulation units that are required to support the operational context.

In the DiMuNDS 2000 project, several sources of requirements were utilized to ensure the resulting federation meets both the initial objective of supporting the Land Component Command within an operational context

as well as the future objective of supporting additional Component Commands. Requirement sources include the requirements from the previous DiMuNDS confederation, interviews and discussions with each of the Component Commands, and the objectives of the MNWG. Representatives from the NC3A developed the requirements based on their experiences with on-going training exercises and systems that support similar operational contexts.

3.3 Design Federation

The federation design activities are conducted to apply the real world abstraction that is represented in the Conceptual Model to a federation of applications that can be developed, integrated, tested, and executed to support the users' requirements. The design defines the set of federates that will be required to simulate the system, the federates' roles and responsibilities, the detailed scenario definition, and the definition of the data that will be exchanged within the federation. The design will be documented within a Federation Object Model (FOM), a Federation Description Document and accompanying documentation as needed.

The DiMuNDS 2000 design process began upon the agreement of the conceptual model. Based on the Conceptual Model the responsibility of each federate was defined. The allocation of responsibilities to each federate is shown in Figure 3.



Figure 3: Allocation of Federate Responsibilities

Based on the conceptual model a high level Object & Interaction Model was constructed that includes the range of object types and interactions required by the scenario. The group then mapped out the publication and subscriptions for each federate. Each federate developer is now responsible for specifying the attributes it requires for all objects that it will be publishing and subscribing and the parameters it requires for all interactions it will be publishing and subscribing.

3.4 Develop Federation

The development of the federation is conducted to develop the constituent applications and system inputs that conform to the

federation design. The development activities will include adaptation of applications to the Federation Object Model (FOM), instantiation of the federation execution scenario, and unit level testing for each federate. If applications were not previously HLA compliant then it will also be necessary to integrate the application with the HLA Run-Time Infrastructure (RTI).

Representatives from each of the participating nations will perform the necessary modifications to their federate applications. These modifications may include: integration with the RTI, conformance to the FOM, development of scenario input files, testing of the federate, as well as other requirements specific to the application.

3.5 Integrate and Test Federation

The integration and testing activities are conducted to bring together the system components in a systematic manner to ensure each component and the overall system meets the users' requirements and operates within acceptable performance constraints.

Representatives from the NC3A will work with representatives of the participating nations to perform integration and testing of the federation execution. A series of integration and test sessions will be conducted on national federates as they become available. These partial system tests reduce the difficulty in understanding anomalies within the system and ultimately reduce the amount of time and effort required for the full system integration and test. Full system integration and testing will occur after all federation components have completed their federation development activities.

3.6 Execute Federation and Analyze Results

The federation execution activities occur to fulfill the users' requirements. These activities are considered the production system execution and occur after the federation has successfully completed integration and testing.

Representatives from the NC3A, the participating nations, the military sponsors, the NATO Modelling and Simulation Group (NMSG), the NATO Simulation Coordination Office (SCO), and the other NATO nations will participate in the demonstration of the executing federation within an operational context. In addition to the demonstration, documentation of the DiMuNDS 2000 project and the lessons learned will be provided to the participants.

4 CONCLUSION

The DiMuNDS 2000 is a pre-pathfinder activity that is developing a federation to build federation development skills within NATO as a first step to supporting the training of the Command staff of the Combined-Joint Task Force.

The federation is following the HLA Federation Development and Execution Process (FEDEP) and will capture the steps that are particular to NATO or multinational federations. Demonstrations of the DiMuNDS 2000 federation will commence in July 2000 and end in September 2000.

5 REFERENCES

DMSO: Department of Defense High Level Architecture Federation Development and Execution Process Model, Version 1.4 Draft, June 1999a.

DMSO: Department of Defense High Level Architecture Federation Development and Execution Process Checklists, Version 1.4 Draft, May 1999b.

AUTHOR BIOGRAPHIES

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